

INTERATIONAL AIRCRAFT MATERIALS FIRE TEST WORKING GROUP MEETING

MARCH 20-21, 2006

TROPICANA HOTEL-CASINO, ATLANTIC CITY, NEW JERSEY, USA

MONDAY, MARCH 20, 2006

Discussion of Burnthrough Test Method for Aircraft Thermal Acoustic Insulation Blankets – T. Marker

Presentation of different types of burner draft tubes and problems encountered. Measurements of FAATC flanged burner taken and compared to measurements of socket-style burner. FAATC extended draft tube of flanged burner. Next, the FAATC measured airflow out of each type of burner. Four diameter measurements were taken of each type of burner, exit velocity was mapped. Graphs of air velocity maps were shown. Photo of RTV sealant added to blade edge of stator. Photos of possible simple modifications to socket burner (1 3/8" disc, 1 5/8" disc, 1 1/4" disc, ring, discs in front of stator, and other modifications tried).

Slight differences in burner housings/draft tube result in higher exit air velocity when using the socket-style burner.

Findings of other adjustments/modifications reviewed.

Tim reviewed the planned activities including: conduct a socket-burner round robin using original FAA burner as a control, supply modified stators to participating labs that currently use the socket style burner, consider blueprinting optimal stator, reproduce via machining (no casting), and develop a new stator for future use, which can be produced via machining.

Is it possible to make/convert one burner into the other type of burner? Tim: No, just based on the draft tube and other parts mounted to the burner, it is probably not possible.

There is a difference between the different types of materials and how they perform, some materials may be more sensitive to the velocity and some types of materials may fail from the heat flux. Both of these have to be considered. Jim Peterson believes there may be more variables that have not been discovered yet. Dave Erb suggested that more tests may need to be done. Dan Slaton brought up concerns about consistency of materials that may lead to variations in burnthrough test results. Dick indicated that there are lots of materials out there that will pass any burner. Everyone is waiting for the burners to be tweaked and tweaked, so the lightest materials will pass the burnthrough tests. We hear that there are not enough burners out there to run a round robin, but everyone has to be conducting the tests the same way, but as we found with past round robins, everyone is not conducting their tests the same way.

Burnthrough: Alternative Burner Apparatus – R. Ochs

Rob reviewed his presentation from the October 2005 meeting for anyone who did not attend that meeting.

Step 1: A sonic nozzle was purchased by the FAATC.

Step 2: Replace electric motor/create a pressurized fuel tank. Performed fuel flow rate measurements with a graduated cylinder and stopwatch. Used a Monarch 6.5 GPH 80° PL type nozzle. Measured fuel flow rates for a range of fuel tank pressures.

Step 3: Draft tube/ignition: plan to reconstruct a draft tube to similar specifications.

Diagram of proposed replacement apparatus was shown. Photo of this apparatus was also shown. Velocity mapping was done on the new apparatus as Tim had done with the original FAATC burner. Average velocity of alternate burner was 227 and 231. Average velocity of original was 231.

Initial calibration – Heat Flux and Temperatures.

Initial burnthrough times. Three materials were tested: 8 oz. Tex-Tech, 14 oz. Tex-Tech, and Nextel paper.

Plan:

Step 1: Completed: Construct apparatus to similar specifications as original burner.

Step 2: Characterize output, compare with desired output from specifications.

Step 3: Steps to take if output is not similar.

Jim Davis: Have you looked at other ways to atomize fuel and create turbulent airflow? Rob: Yes, we have, and we will test some of these options. H.P. Busch: Have you used the same stator and tubes that are used on the original burner? Rob: We can run tests with those. Dick: The original idea was to build a new burner to give the same results. It would be a burner that any shop could build, however, several people brought up how difficult it is to obtain a Park Oil burner right now. Scott Campbell: Do you know the approximate cost? Rob: We haven't gone through that yet.

Burnthrough Advisory Material – R. Hill/J. Gardlin

This information is also available in the Meeting Presentations section of the Materials Page on the Fire Safety Branch website at www.fire.tc.faa.gov.

Jeff: We recognized that there are currently four airframe manufacturers that will be affected by this rule. Because of this, we decided to address each manufacturer individually. We determined the following after reviewing the requirements:

Lower lobe cargo doors: lower lobe cargo doors leading into class C cargo compartments, and having a complete liner on the door meeting the requirements of ceiling portion of appendix F, Part III, do not require modification to the insulation.

Passenger doors: if less than 12" is in the lower half, no modification required. If 12" or more, and insulation is mechanically fastened, add barrier material to insulation, but no test for attachment required.

Wing box: The wing box itself does not require improved insulation (assuming it is insulated). Note that the insulation on outer skin in the fuselage above the wing box does require improved burnthrough protection (lower half only).

Fasteners (not already covered in AC 25.856-2): Fasteners that maintain the barrier and are potentially exposed to the fire do not require testing, if they are of a materials whose melting point exceeds the fire temperature. Other fasteners should be demonstrated by test. Fasteners that are not exposed to the fire can be aluminum or high temperature plastic. Attachments to the structure need not be tested if the attachment to the structure is not critical in maintaining the barrier.

Installation (attachment tests): The attachment test is primarily to ensure the continuity of the barrier, rather than fire resistance of the material system.

Window line: Some allowance may be possible if the half-way point intersects the passengers windows. That is, adding insulation between closely spaced windows will not contribute to burnthrough protection in some cases. However, the variation in design is too great to generalize this.

We will try to capture these things as publicly available additional guidance material. We are still determining how we will do this.

Questions:

Francisco Landroni: Embraer does not have insulation in the wing box in their aircraft, how does this apply. Jeff: if there is no insulation above the wing box, the rule does not apply, but there are some

applications where there is insulation above the wing box. We will try to make this more clear when we put it out in final form. Jacques Robillard: How do you intend to put this out, as an advisory circular? Jeff: We will make something available to everyone. We are still deciding the best form to do this. Dick: It has to be in a form that the authorities will recognize it, maybe as part of the Aircraft Materials Fire Test Handbook. Jacques Robillard: It will be helpful as it is. Jeff: We will distribute this to the FAA ACO's and other authorities. George Danker: We understand the value of recognition by authorities, but there is a time value also, that's why we are asking. Jeff: Remember, you have to take it for what it is until the authorities are all made aware of these. My first thought is to put something on the FAATC Fire Safety Website, then follow it up with something in the Aircraft Materials Fire Test Handbook or similar.

Results of Radiant Panel Testing – Round Robin 8 – P. Cahill

Round Robin 8 Information: 18 participating labs, 3 materials, 3 samples of each material, all warp direction

Polyimide Film results reviewed: after-flame, flame propagation, photos of polyimide film samples after FAATC lab tests.

Polyester Film results reviewed: after-flame, flame propagation, photos of polyester film samples after FAATC lab tests.

Metallized Tedlar with Tape (plain Tedlar tape): after-flame, flame propagation, photos of Metallized Tedlar (with tape) samples after FAATC lab tests.

Heat Flux Comparison

Controller Setpoint Comparison graph

Stabilization Time Comparison graph – Pat indicated that the FAATC lab is Lab “P” on this chart

Observations of Round Robin 8:

Calorimeter cooling water cannot be too hot. Keep in mind that it's cooling water and the water temperature should be checked periodically.

There were no significant differences in test results during this Round Robin with the labs using Kaowool vs. other refractory board.

Labs using an Electric Radiant Panel that are experiencing higher than average stabilization times should check their controller settings for their mode of operation.

Non-Participating Labs will be included in future Round Robins.

A lot of you know that we made training videos for the radiant panel and one for the burnthrough tests. Pat sent the radiant panel video out to a few labs for comments. Jeff Gardlin and one lab made comments. The video link is on the FAATC Fire Safety Branch website. This is just a “how to conduct radiant panel tests” video not an Advisory Circular video for the radiant panel. Comments are welcome – as soon as possible. <http://www.fire.tc.faa.gov/video.stm> = link to radiant panel video

Dick (to WG): Do you think we need a training video on the AC material for the burnthrough to complement the written AC detail?

Radiant Panel Hook and Loop Advisory Circular Material:

Hook and Loop Material only

Flame propagation versus flame (“Fan”) or deflection

Sample size will be discussed in Task Group meeting

Sewing Hook and Loop samples will also be discussed in Task Group meeting

The FAATC has not tested Hook and Loop samples that have been sewn.

Pat showed video of hook and loop tests conducted at FAATC lab. This video will be included on the FAATC Fire Safety website in the near future.

Hook and loop, damping system and tapes will be included in the AC radiant panel video.

Ed Nixon suggested including a failing sample in the AC radiant panel video. Pat indicated that she would.

Seat Round Robin – P. Cahill/R. Hill

Currently, 8 labs in the United States have oil burners set up for seat testing. Photo of three materials tested in this Round Robin

Testing in the U.S. was completed last year

Testing has not yet started outside the U.S.

We will proceed through the Working Group to begin testing outside the U.S. (Dick Hill's suggestion)

Dick explained: The FAA Transport Directorate will prepare a letter for the European labs that are regulated through EASA. In the U.S., someone from the FAATC and someone from the FAA ACO went to each participating lab to ensure that each lab was inspected and set up correctly to run the tests. We need coordination through the individual authorities and the labs that would be involved so there is technical observation/involvement through the individual authorities or an organization like CEAT. The FAA will prepare the letter to EASA with input from the labs and individual authorities. How will the materials will be shipped? Directly to the individual authorities, EASA, or directly to the labs with oversight by EASA or the individual authorities?

Other countries not regulated by EASA: Switzerland?: would Switzerland be involved in this or work directly with the Swiss authority coordinating with the FAA.

Canada: Claude Lewis will check to see if there is a lab in Canada running the seat burner test.

Brazil: Varig has a burner for seat tests. Coordinate with CTA (Lucia).

Asian Countries: The Los Angeles ACO has oversight over some countries in Asia through a TSO.

Lightweight Seat Cushions – R. Hill

Dick reviewed the Proposed Acceptance Criteria that had been presented by Tim Marker at previous WG meetings. A lightweight seat cushion is one that when configured the bottom and back weighs less than 3 lbs. Tim's complete presentation on this topic is included with the presentations from the October 2005 meeting. Tim is working on the report. Jim Davis: If someone came to our lab and proposed this, can we do this? Dick: Contact the FAA ACO and explain that this was presented in the Materials WG meeting or contact the FAA Transport Directorate. Tim: As a basis for comparison, the typical fire hardened foam seat weighs about 5-5½ lbs.

Proposed Radiant Heat Panel Test for Evaluation of Aircraft Duct Material – J. Reinhardt

John reviewed the objectives of this research. These were previously presented during the October 2005 WG meeting.

<http://155.178.136.36> John set up this website containing all the test data and videos of tests conducted. Contact him to obtain the username and password for this site.

October 2005 Task Group meeting minutes were reviewed.

John reviewed the last quarter tests results of materials provided by Task Group members. Results of intermediate-scale tests were presented for Sample Taped N, Coated/Taped N. Pre-test and post-test photos of taped N were shown.

Radiant Panel Test photos of Taped N and Coated/Taped N were shown. Tom Tompkins: Were these new ducting materials? John: Originally, they were new ducting materials. They were recoated and used over in this series of tests, because I had limited ducting materials to use for these tests. The Radiant Panel Test results of each material for the last quarter were presented. Jim Peterson: Are you referring to measured burn length? John: Yes.

Radiant Panel Test results for Coated B were presented including a graph.

Proposed Radiant Panel Test:

Test Protocol: Based on Appendix F to Part 25 (Part IV) – Test Method to Determine the Flammability and Flame Propagation Characteristics of Thermal/acoustic Insulation Materials

Sample Size: 215.9mm x 279.4mm

Heat Source: Propane Flame & Radiant Heating Coils (147 kW/m² pilot, 17 kW/m² panel).

Heat Source Exposure: One minute exposure to radiant heat, then 10 seconds pilot impingement.

Max Flame Propagation: < 5.08 cm

Max Flame Time: TBD

Eric Mutkus: What about new technologies/lighter materials? Dick: We haven't seen any yet. We will have to research that when they are available.

John showed photo results of the various materials tested and provided burning time and burned area and other data related to each material's test results for radiant panel, OSU, and Smoke Density tests.

Dick: We've been going through the ducting research for several years now. We have published the Task Group minutes and asked for comments on the test method. The comments we received were related to what the test would be used for which is beyond the scope of the FAATC Fire Safety RESEARCH group's objective. Our job is to develop the test and provide it to the FAA Transport Aircraft Directorate (the Regulatory side of the FAA). We need input to make the test the best it can be for when questions on certain materials come up. We need input on realistic test questions. Unless we get input and participation on the test method to make the test method the best it can be, we will conclude the Task Group and give the test method to the FAA regulatory side.

Scott Campbell: I understand about helping with the test method. What is the vehicle to work with the regulatory side to have dialogue with them on what the test method will be used for. Dick: List or document the problems for certain materials as you assist with the development of the test method. Then there is the NPRM. John: I will include all the concerns of industry with the information I provide to the regulatory side. I hope these will be addressed by the regulatory side. Dan Slaton: Our questions to John in the Task Group (ie: what is a duct and how do we test a duct?), we are trying to look at this data and trying to come up with the best test methodology for these materials. I think there is some overlap there.

John indicated several topics that would be discussed during the Task Group meeting on Tuesday, March 21, 2006. Labs were asked to continue sending ducting materials to be tested. He is going to start writing the report on this research.

Electric Wire Insulation Study: Flammable Properties and Testing Methods – R. Ochs

Rob reviewed his presentation from October 2005. He has been busy with the new burner development since October 2005, so he has not had much time to work on this project recently.

He reviewed the previous experimental studies done on electrical wiring.

Quantifiable Fire Performance Parameters

NASA STD-6001

There may be better ways to test electrical wires using a radiant heat source and ignition from surrounding materials than using the radiant panel test as it is used for insulation materials, etc. Rob gave reasons why he will be investigating other types of radiant heat sources for test method development when he continues this research. A further in-depth study of testing configuration effects on test results will be done.

Alternate Wire Flammability Test Procedures for Small Wire Test Specimens – C. Bresciano (Boeing)

14 CFR 25.869(a)(4)

Diagram of 60-Degree Electrical Wire Bunsen Burner Test Set-up currently used to test electrical wire was presented and test method described.

He addressed Appendix F, Part I(a)(3)(b)(7); Handbook Section 4.4.2 – Specimen Length; and Appendix F, Part I(a)(1)(v):

This is a problem when:

The test specimen does not fit in the test fixture (length is less than 30 inches). When the wire breaks prior to the completion of the flammability test.

He described the instances in which the situations he addressed tend to occur. For example: handsets, printers, line replaceable units, in-flight entertainment systems.

Proposed alternate procedures:

Wiring less than 30 inches long: Attach an alternate wire retention device such that the wire specimen will maintain its proper orientation in the test fixture.

-Use of alligator clips (showed a diagram of what this set-up would look like)

When the wire breaks prior to the completion of the flammability test:

Use nickel chromium ribbon as an alternate wire retention device – description of how to use this was provided and a diagram of this set-up was shown. This is used at Boeing (Renton) for small gauge wire. It has been approved by the FAA Seattle ACO.

Proposal: Allow industry to submit alternate test procedures to FAATC for evaluation and approval. Incorporate these proposed alternate test procedures into the Aircraft Materials Fire Test Handbook.

Dick: With the test with the ribbon, what keeps the wire from falling in? Chris: It doesn't fall all the way down. It may move away from the ribbon slightly. It falls closer to the flame if anything. I have never seen the wire fall completely off the ribbon. Chris: I would like to conduct a comparison test with the nickel chromium ribbon and some larger gauge wires vs. smaller gauge wires.

Pat: The small gauge wire problem you described is a common problem. Chris: That's why we'd like to get this alternate procedure into the Handbook if possible. Scott Campbell: We've used the alligator clips for several years both at Douglas and at C&D. We've tried to use a lighter weight for the smaller gauge wires.

Hector Alcorta: Are there any plans to start addressing the issue of wire bundles? Chris: No, we do not test bundles with this test. This test is for a single wire or a multi-conductor cable, not wire bundles. Rob Ochs is working on the test for wire bundles.

TUESDAY, MARCH 21, 2006

Task Group Reports

Radiant Heat Panel Task Group – P. Cahill

There is a “rule of 7” mechanism in place now.

Backer boards: We have a plan to look at the Kaowool M Board vs. Fermacil vs. a board that is equivalent to the Kaowool M Board. Is there a difference in results with different materials, etc.? H.P. Busch: Airbus is no longer allowed to use Kaowool, because it is considered hazardous.

24-hour conditioning period was discussed. Is there something that can be done to exempt a material from the 24-hour conditioning period? The Task Group will look into this.

The data from Round Robin 8 was distributed to the Task Group members.

Burnthrough Task Group – T. Marker

Main points:

We will run a round robin with the socket burners. FAATC will ensure labs have burners set up properly. FAATC will ensure stators work correctly in their facility before sending them to the participating labs.

Nozzles for new burner design will be investigated. Bert will investigate jet engine-type nozzles and report back to group.

Calibration material. Rob Ayerst asked why can't a metal sheet be used? Tim explained that they had found that an aluminum sheet melts and stays there and causes a fluctuation. Dick: We found that many materials are ablative and are affected by velocity. Different materials are sensitive to different variables.

Blueprinting/development of a reproducible stator for current burners and the new burner, so everyone can be assured that they have the proper stator.

Ducting Task Group – J. Reinhardt

The data was discussed.

The reason for using the ignition source that is used was discussed.

Task Group members had not had time to look at the data prior to this meeting, so they decided to meet again prior to the July WG Meeting.

OSU Round Robin Plans/Program – R. Johnson

We would like to have a round robin on the OSU. For those of you who have been involved in this working group for several years, you know that Mike O'Bryant at Boeing has done a round robin within Boeing with Boeing suppliers and found a wide discrepancy. We were asked to do a round robin with the OSU as we have recently done with the seat round robin. We would like to conduct a worldwide round robin through this Working Group. We would like WG members input on how we can organize this worldwide OSU Round Robin. A previously compiled list of labs with OSUs was presented and WG members were asked if there are additional labs, and if the information needs to be updated.

Please let Dick Johnson at the FAATC know the updated information. The FAA would like to figure a way to keep some oversight on this Round Robin. Does Europe want to be involved in this RR?

There has to be some mechanism by which there is oversight in order to find problems and to ensure that labs are set up correctly and conducting the tests correctly. Scott Campbell: suggested a

questionnaire to each participating lab asking for measurements and photographs and asking key questions, or offer some training to those who will be conducting the RR tests. Dick Johnson: I have seen many labs over the years and seen many things in those labs or with that equipment set up that caused wide discrepancies in the results. Dick Hill: Maybe a lab videotaping their tests would work?? Rich Lyon: We have a research version of the OSU that we could use if we would be developing some diagnostics systems, so we could have an analysis of the equipment problems at each lab that can be given to the lab for correction. We would be willing to do the scoping research on this. Dick Hill: Any other thoughts on how to proceed with this RR? Gus: Is there a way to do a mini RR to see what the outliers are and focus your attention on these labs? We know some of the problems with some of the materials. Dick Hill: That is kind of what Mike O'Bryant's RR has been in the past. I don't know that that approach has been that effective so far. Gus: This approach may provide information on which labs are the outliers to narrow down which labs need a visit. H.P. Busch: There is no question that Airbus wants to be a part of this. Dick Hill: We are ready to start the RR now. We need some kind of agreement as to how to proceed with this RR, so that we can start it very soon. Dick Johnson has three different materials prepared for the RR, and Boeing is going to supply two materials. Dan Slaton: It would probably be very beneficial to prepare a survey/questionnaire to identify key characteristics, and Rich Lyon can work on the analysis side of this. Dick Hill: I am not sure how effective a survey would be without the oversight. A survey only goes so far. Every lab that Pat and Do went to see in the seat RR said that they were running the tests properly, yet they found quite a few problems when they actually saw the labs. Do we want photos, video, and a survey? Scott Campbell: Dick Johnson had some tools that helped labs measure areas of the OSU. Maybe Dick Johnson could send out the specs for these tools, so that labs could make these. Maybe he could send some tips for measuring and using these tools. H.P. Busch: Could you photograph these tools. Dick Johnson: Every lab that I visited I brought those tools that I made to make my job easier, and many labs traced those tools and made them for their own use. Dick Hill: We will put together a package of what we want from each lab as far as photos, videos, questionnaires. We will coordinate with Jeff Gardlin for U.S. labs. We will coordinate with Lucia Nunes for the labs in Brazil. Is there someone from Airbus who will be the focal point for Europe for coordination purposes within Europe? H.P. Busch will find out if he or someone from Airbus can be the European point of contact for this RR. H.P. Busch: We should make a concrete timeframe for this RR. Dick Hill: We will set the end of April 2006 as the deadline to have everything defined on how we will proceed. Heiko Nuessel: what about the NBS Chamber? Dick Hill: Do we want to do a smoke chamber RR as well? Jim Peterson: Yes. Other WG member labs agreed. Dick Johnson has already cut samples for the NBS chamber. Dick Hill: We need an updated list of OSU labs from each region.

Standard Test Method for Flammability Screening of Aircraft Materials - R. Lyon

Flammability properties from microcalorimetry

Goal of this effort is to be able to come up with a small-scale screening test. We needed a test where we could test milligram samples to get an indication of how they would perform in the OSU, NBS, and other larger-scale tests. Rich described how the microcalorimeter works through simulated flaming combustion. He explained the construction of the apparatus. Rich explained the data that are obtained from a material tested in the microcalorimeter. This test obtains rapid results and is reproducible/repeatable and measures fire properties (HRR, heat release capacity, ignitability, can calculate a critical heat flux from ignitability, and flame resistance). Rich reviewed the current limitations of method including physical effects not captured in these test results: dripping, etc. Work items are submitted to ASTM and ISO to standardize this test method. This should soon be an international standard. Does this group see any value in including this test in a standardized format in the *Aircraft Materials Fire Test Handbook*? The apparatus can be adapted to aircraft materials. H.P. Busch: The intention of all of the aircraft materials tests is to test the aircraft materials as installed. Can you make the smaller scale sample test results comparable to the results of the aircraft material tests such as the OSU.

New Work at FAATC

Composite Skin Burnthrough Testing Apparatus – R. Hill/T. Marker

The FAATC will be looking into a laboratory test to evaluate composite aircraft skin. Toxicity and how it relates to survivability is a key factor in this evaluation. One of the first steps was to compare this to burnthrough materials. We tried to develop a method to collect the materials/smoke that come off the back side of the composite material. Photos of this box test were shown. This is a first attempt to collect these materials – presented a photo showing where the materials from the back side of the test would be collected.

Gas Analysis and Toxicity Assessment of Combustion Products of Aircraft Materials – L. Speitel

Dick first explained that this is a complex process.

FAA gas analysis instrumentation.

FAA toxicity method.

FTIR Method.

FTIR Results.

Louise presented photographs of the various gas analysis equipment used at the FAATC. She reviewed the requirements for toxicity assessment of combustion gases.

Next Meeting

July 11-12, 2006

Hosted by C&D Zodiac, Inc. at the Westin South Coast Plaza, Cost Mesa, CA

For hotel reservations go to:

<http://starwoodmeeting.com/StarGroupsWeb/res?id=0512075260&key=68119>

Meeting Registration forms will be available at www.fire.tc.faa.gov on the Materials Group Page under "Meetings".

Scott Campbell provided information on the Southern California area near where the meeting will be held. He provided information on some of the activities that will be hosted by C&D Zodiac, Inc., for the WG members. A registration area for these activities will be provided on the Meeting Registration Form. There are only 150 spaces available to attend this meeting.

The Contamination Task Group met on the afternoon of March 21, 2006.